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AN EXPERIMENTAL ANALYSIS OF DIRECT EVAPORATIVE COOLER BY VARYING MATERIALS OF COOLING PAD

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ABSTRACT

This research aims to examine the performance of the direct evaporative cooler, by using the cooling pads of different materials. The efficiency of direct evaporative cooler mostly depends on the cooling pad and hence, the material used in the cooling pad plays a very vital role. Here, the performance of direct evaporative cooler is analyzed by using cooling pads of four different materials such as cellulose paper pad, wood fibers, wood wool (Aspen) and coconut fibres. Apart from these four types of cooling pads, also the performance of direct evaporative cooler is analyzed by using three different types of cooling pads simultaneously on three sides of the cooler, which mainly includes cellulose paper pad, coconut fibre pad and wood wool (Aspen) pad. Two most important terms considered in this analysis are temperatute and humidity. The readings of these two terms are taken for each type of cooling pad and also, the further calculations are done based on these readings. Comparison of results for various types of cooling pad is also done. The paper rounds off with conclusions and an agenda for future research in this area.

KEYWORDS: Evaporative, Humidity, Temperature, Pad, Cooler & Analysis

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Original Article

INTRODUCTION

Direct evaporative cooling (DEC) uses evaporating water, combined with a wetted medium to cool the temperature of air as it passes through. Heat is removed from the surrounding air in the vaporization of the water by passing through or around a wetted surface. The air is cooled in the process and the humidity is increased. Unfortunately, evaporative cooling requires an abundant water source and is only effective when the relative humidity is low, restricting its efficient use to dry climates. The air supplied by the evaporative cooler is nearly 100% humid. Very humid air prevents the evaporative cooling of sweaty or wet skin. High humidity in air accelerates corrosion. This can considerably shorten the life of electronic equipment. High humidity in the air may cause condensation (which can be extremely hazardous, if it happens inside electrical equipment). Cooled air may bring dust and pollen into the space, causing discomfort for allergy sufferers. Growth of microorganisms such as molds on the cooler pads may cause allergy problems in sensitive individuals, as evaporative coolers use on-site water.

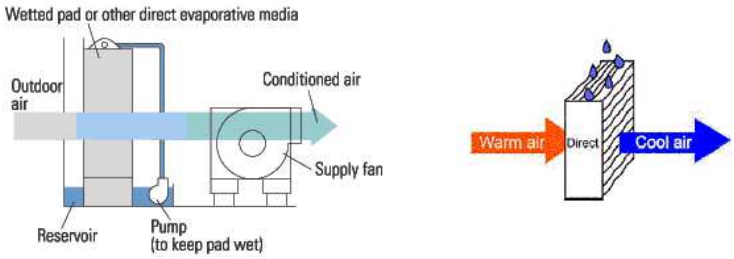

Figure.1: Direct Evaporative Cooling System

COOLING PADS

Cooling pads have a very high impact on the performance of a direct evaporative cooler. Cooling efficiency and humidity are the two important factors to be considered while analyzing the performance of an direct evaporative cooler. These two factors, mostly depend upon the type of cooling pad used. Now a days, cooling pads of materials such as Aspen wood wool, wood fibers and cellulose paper pad are being used in the direct evaporative coolers. Though these pads are giving a good cooling efficiency, but they also increase the humidity. So, this increased humidity is the major problem today in case of these direct evaporative coolers. Researchers from all over the world are trying to search or develop new, efficient and sustainable pad materials which is very much required for further enhancing cooling potential of evaporative cooling devices. In the present work, one new cooling pad material, i.e. Coconut fiber has been tested. The views of the various types of cooling pad materials used in this work are given in the following figures.

Figure 2: Wood Fibers

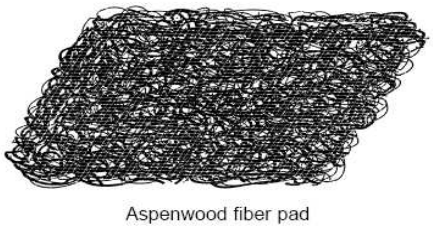

Figure 3: Aspen Wood Wool

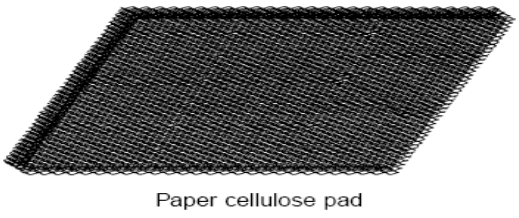

Figure 4: Cellulose Paper Pad

Figure 5: Coconut Fibers

EXPERIMENTAL ANALYSIS

The cooling pads of all the above four types of materials were prepared and tested experimentally one by one in a prepared model of a direct evaporative cooler. Apart from these four types of cooling pads, also the model of a direct evaporative cooler has been tested by using three different types of cooling pads on its three different sides and they include cellulose paper pad, Aspen wood wool pad and Coconut fiber pad. In this way, five times experimentations were performed by varying the cooling pads and the readings of temperature and humidity were taken. The comparison between the readings of various types of cooling pad is given in the following table.

Table 1: Experimental Readings

Sr. No.	Cooling Pad Material	Inlet Dry Bulb Temperature (^{0}C)	Humidity (%) Before Cooling	Outlet Dry Bulb Temperature (^{0}C)	Humidity (%) After Cooling
1	Wood fibers	28	56	25	70
2	Aspen wood wool	28	57	23	73
3	Cellulose paper pad	30	55	22	72
4	Coconut fibers	27	59	24	68
5	Cellulose, Aspen & Coconut fibers mixture	28	60	22	68

Based on the above readings, the efficiency of an direct evaporative cooler can be calculated as given below.

Considering wood fibers as a cooling pad material.

From the psychometric chart,

For DBT = 28^{0}C and Humidity = 56%,

We get Wet bulb temperature(WBT) = 19 ^{0}C

Now, cooling efficiency is given by,

Cooling efficiency = [(t1-t2)/(t1-ts)]*100

Where, t1=Inlet DBT, t2=outlet DBT, ts=WBT

Therefore, from the above the cooling efficiency for wood fibers is 33.33%

In the similar way, the cooling efficiency for other cooling pad materials can be found.

RESULTS

The comparison of results of the cooling efficiency for various types of cooling pads is shown in the following

table.

Table 2: Comparison of Cooling Efficiency

Sr. No.	Cooling Pad Material	Cooling Efficiency (%)
1	Wood fibers	33.33
2	Aspen wood wool	55.85
3	Cellulose paper pad	80
4	Coconut fibers	33.33
5	Cellulose, Aspen & Coconut fibers mixture	66.66

CONCLUSIONS

- An experimental analysis of an direct evaporative cooler by varying materials of cooling pads have been performed.
- From the analysis it is found that Cellulose paper pads and Aspen wood wool pads provides good cooling but they increases the humidity very highly and Coconut fiber pads has least humidity.
- So, a mixute of these three cooling pads i.e. Cellulose paper pad, Aspen wood wool and Coconut fibres is prepared and it is seen from the experiment that this mixture provides a good cooling effect and also has a least humidity.

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